WHAT IS CLAIMED IS:

1. An epoxy-capped polythioether having the following structural formula:

$$R^1(-S-R^2-CH(O)CH_2)_2$$

wherein

R^1 is selected from the group consisting of C_{2-6} n-alkylene, C_{3-6} branched alkylene, C_{6-8} cycloalkylene, C_{6-10} alkylcycloalkylene, and $-[-(CHR^3)_p-X-]_q-(CHR^3)_r-$,

wherein

each R^3 is independently selected from H, and $-CH_3$

each X is independently selected from O, S, –NH–, and $-NR^4-$,

R^4 is selected from H, and $-CH_3$,

p is an integer from 2 to 6,

q is an integer from 1 to 5, and

r is an integer from 2 to 10,

and each R^2 is a divalent linking group.

2. The epoxy-capped polythioether of claim 1, wherein R^1 is derived from a compound selected from the group consisting of dimercaptodioxaoctane, and dimercaptodiethylsulfide.

3. The epoxy-capped polythioether of claim 1, wherein each R^2 is derived from an olefin.

4. The epoxy-capped polythioether of claim 3, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 20 carbon atoms, and an oxyalkylene having from 3 to 20 carbon atoms.

5. The epoxy-capped polythioether of claim 3, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 5 carbon atoms, and an oxyalkylene having from 3 to 5 carbon atoms.

6. The epoxy-capped polythioether of claim 1, wherein each R^2 is derived from a compound selected from the group consisting of allyl glycidyl ether, 1,2-epoxy-5-hexene, 1,2-epoxy-7-octene, 1,2-epoxy-9-decene, 4-vinyl-1-cyclohexene 1,2-epoxide, butadiene monoepoxide, isoprene monoepoxide, and limonene monoepoxide.

7. The epoxy-capped polythioether of claim 1, which is free of hydrolysable chlorine.

8. An epoxy-capped polythioether having the following structural formula:

$$B\,(-CH_2-CHOH-R^2-S-R^1-S-R^2-\underset{\displaystyle O}{CH}-CH_2)_z$$

where R^1 and R^2 have the meanings set forth in claim 1, B is a multivalent radical, and z is a number corresponding to the valence of B.

9. The epoxy-capped polythioether of claim 8, wherein each R^1 is independently derived from a compound selected from the group consisting of dimercaptodioxaoctane, and dimercaptodiethylsulfide.

10. The epoxy-capped polythioether of claim 8, wherein each R^2 is derived from an olefin.

11. The epoxy-capped polythioether of claim 10, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 20 carbon atoms, and an oxyalkylene having from 3 to 20 carbon atoms.

12. The epoxy-capped polythioether of claim 10, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 5 carbon atoms, and an oxyalkylene having from 3 to 5 carbon atoms.

13. The epoxy-capped polythioether of claim 8, wherein each R^2 is derived from a compound selected from the group consisting of allyl glycidyl ether, 1,2-epoxy-5-hexene, 1,2-epoxy-7-octene, 1,2-epoxy-9-decene, 4-vinyl-1-cyclohexene 1,2-epoxide, butadiene monoepoxide, isoprene monoepoxide, and limonene monoepoxide.

14. The epoxy-capped polythioether of claim 8, which is free of hydrolysable chlorine.

15. The epoxy-capped polythioether of claim 8, wherein z is from 3 to 6.

16. The epoxy-capped polythioether of claim 8, having an average functionality between 2.05 and 3.

17. The epoxy-capped polythioether of claim 8, wherein B is derived from a compound selected from the group consisting of a polyacid, a polyamine, a polyanhydride, and a polythiol.

18. A curable composition comprising:

    (a) at least one epoxy-capped polythioether of claim 1; and

    (b) at least one curing agent.

19. The curable composition of claim 18, wherein the at least one curing agent is selected from the group consisting of a polyacid, a polyamine, a polyanhydride, and a polythiol.

20. The curable composition of claim 18, further comprising at least one adjuvant resin different from (a) and (b).

21. The curable composition of claim 18, further comprising at least one filler.

22. The curable composition of claim 18, further comprising at least one additive selected from the following: plasticizers, pigments, cure accelerators, adhesion promoters, thixotropic agents, fire retardants, masking agents, antioxidants, and surfactants.

23. The curable composition of claim 18, which is free of hydrolysable chlorine.

24. A curable composition comprising:

(a) at least one epoxy-capped polythioether of claim 8; and

(b) at least one curing agent.

25. The curable composition of claim 24, wherein the at least one curing agent is selected from the group consisting of a polyacid, a polyamine, a polyanhydride, and a polythiol.

26. The curable composition of claim 24, further comprising at least one adjuvant resin different from (a) and (b).

27. The curable composition of claim 24, further comprising at least one filler.

28. The curable composition of claim 24, further comprising at least one additive selected from the following: plasticizers, pigments, cure accelerators, adhesion promoters, thixotropic agents, fire retardants, masking agents, antioxidants, and surfactants.

29. The curable composition of claim 24, which is free of hydrolysable chlorine.

30. An epoxy-capped polythioether formed by reacting *n* moles of a compound having the structure of Formula I,

$$HS - R^1 - SH \qquad I$$

wherein

R^1 is selected from the group consisting of C_{2-6} n-alkylene, C_{3-6} branched alkylene, C_{6-8} cycloalkylene, C_{6-10} alkylcycloalkylene, and $-[-(CHR^3)_p-X-]_q-(CHR^3)_r-$,

wherein

R^3 is selected from H, and $-CH_3$,

each X is independently selected from O, S, –NH–, and $-NR^4-$,

R^4 is selected from H, and $-CH_3$,

p is an integer from 2 to 6,

q is an integer from 1 to 5, and

r is an integer from 2 to 10,

or a mixture of at least two different compounds having the structure of Formula I, with *n+1* moles of a compound having the structure of Formula II:

II

wherein R^2 forms a divalent linking group,

or a mixture of at least two different compounds having the structure of Formula II.

31. The epoxy-capped polythioether of claim 30, wherein R^1 is derived from a compound selected from the group consisting of dimercaptodioxaoctane, and dimercaptodiethylsulfide.

32. The epoxy-capped polythioether of claim 30, wherein each R^2 comprises an olefin.

33. The epoxy-capped polythioether of claim 32, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 20 carbon atoms, and an oxyalkylene having from 3 to 20 carbon atoms.

34. The epoxy-capped polythioether of claim 32, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 5 carbon atoms, and an oxyalkylene having from 3 to 5 carbon atoms.

35. The epoxy-capped polythioether of claim 30, wherein each R^2 is derived from a compound selected from the group consisting of allyl glycidyl ether, 1,2-epoxy-5-hexene, 1,2-epoxy-7-octene, 1,2-epoxy-9-decene, 4-vinyl-1-cyclohexene 1,2-epoxide, butadiene monoepoxide, isoprene monoepoxide, and limonene monoepoxide.

36. The epoxy-capped polythioether of claim 30, which is free of hydrolysable chlorine.

37. The epoxy-capped polythioether of claim 30, having an epoxy equivalent weight range less than 300.

38. The epoxy-capped polythioether of claim 30, having an epoxy equivalent weight range less than 150.

39. The epoxy-capped polythioether of claim 30, which is formed in the presence of a catalyst selected from the group consisting of a free-radical catalyst, an ionic catalyst, and ultraviolet light.

40. The epoxy-capped polythioether of claim 39, wherein the catalyst does not comprise an acidic or basic compound and does not produce acidic or basic compounds upon decomposition.

41. The epoxy-capped polythioether of claim 39, wherein the catalyst comprises a free-radical catalyst.

42. The epoxy-capped polythioether of claim 41, wherein the free-radical catalyst is selected from the group consisting of azo-type catalysts, and alkylperoxides.

43. An epoxy-capped polythioether formed by reacting a compound having the structure of Formula I,

$$HS - R^1 - SH \qquad I$$

wherein

R^1 is selected from the group consisting of C_{2-6} n-alkylene, C_{3-6} branched alkylene, C_{6-8} cycloalkylene, C_{6-10} alkylcycloalkylene, and $-[-(CHR^3)_p-X-]_q-(CHR^3)_r-$,

wherein

R^3 is selected from H, and $-CH_3$,

each X is independently selected from O, S, –NH–, and $-NR^4-$,

R^4 is selected from H, and $-CH_3$,

p is an integer from 2 to 6,

q is an integer from 1 to 5, and

r is an integer from 2 to 10,

or a mixture of at least two different compounds having the structure of Formula I, with a compound having the structure of Formula II:

II

wherein R^2 forms a divalent linking group,

or a mixture of at least two different compounds having the structure of Formula II, and with a polyfunctionalizing agent, or a mixture of at least two different polyfunctionalizing agents.

44. The epoxy-capped polythioether of claim 43, having an average functionality between 2.05 and 3.

45. The epoxy-capped polythioether of claim 43, wherein the polyfunctionalizing agent has a valence of 3.

46. The epoxy-capped polythioether of claim 43, wherein the functionality of the polyfunctionalizing agent is selected from the group consisting of acid groups, amine groups, anhydride groups, and thiol groups.

47. The epoxy-capped polythioether of claim 43, wherein the polyfunctionalizing agent is selected from the group consisting of a polyacid, a polyamine, a polyanhydride, a polythiol, and mixtures thereof.

48. The epoxy-capped polythioether of claim 43, wherein each R^2 comprises an olefin.

49. The epoxy-capped polythioether of claim 48, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 20 carbon atoms, and an oxyalkylene having from 3 to 20 carbon atoms.

50. The epoxy-capped polythioether of claim 48, wherein the olefin is selected from the group consisting of an alkylene having from 3 to 5 carbon atoms, and an oxyalkylene having from 3 to 5 carbon atoms.

51. The epoxy-capped polythioether of claim 43, wherein each R^2 is derived from a compound selected from the group consisting of allyl glycidyl ether, 1,2-epoxy-5-hexene, 1,2-epoxy-7-octene, 1,2-epoxy-9-decene, 4-vinyl-1-cyclohexene 1,2-epoxide, butadiene monoepoxide, isoprene monoepoxide, and limonene monoepoxide.

52. The epoxy-capped polythioether of claim 43, which is free of hydrolysable chlorine.

53. The epoxy-capped polythioether of claim 43, having an epoxy equivalent weight range less than 300.

54. The epoxy-capped polythioether of claim 43, having an epoxy equivalent weight range less than 150.

55. The epoxy-capped polythioether of claim 43, which is formed in the presence of a catalyst selected from the group consisting of a free-radical catalyst, an ionic catalyst, and ultraviolet light.

56. The epoxy-capped polythioether of claim 55, wherein the catalyst does not comprise an acidic or basic compound and does not produce acidic or basic compounds upon decomposition.

57. The epoxy-capped polythioether of claim 55, wherein the catalyst comprises a free-radical catalyst.

58. The epoxy-capped polythioether of claim 57, wherein the free-radical catalyst is selected from the group consisting of azo-type catalysts, and alkylperoxides.